U.S. ARMY

Center for
Army
Analysis

AESOP

MARCH 2000

DISTRIBUTION STATEMENT A:
Approved for Public Release -
Distribution Unlimited

CENTER FOR ARMY ANALYSIS
6001 GOETHALS ROAD
FORT BELVOIR, VA 22060-5230

DISCLAIMER

The findings of this report are not to be construed as an official Department of the Army position, policy or decision unless so designated by other official documentation. Comments or suggestions should be addressed to:

Director
Center for Army Analysis
ATTN: CSCA-RA
6001 Goethals Road
Fort Belvoir, VA 22060-5230

CAA-R-01-15

REPORT DOCUMENTATION PAGE			*Form Approved* *OMB No. 074-0188*
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503			
1. AGENCY USE ONLY (Leave blank)	**2. REPORT DATE** March 2001	**3. REPORT TYPE AND DATES COVERED** Final, August 1999 - March 2001	
4. TITLE AND SUBTITLE Analysis of Energy Saving Outsourcing Portfolio			**5. FUNDING NUMBER**
6. AUTHOR(S) Mr. James Keller, Jr.			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Center for Army Analysis** **6001 Goethals Road** **Fort Belvoir, VA 22060-5230**			**8. PERFORMING ORGANIZATION REPORT NUMBER** CAA-R-01-15
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Office of the Asst Chief of Staff for Installation Mgmt ATTN: DAIM-FD 600 Army Pentagon Washington, DC 20310-0600			**10. SPONSORING / MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; dissemination unlimited			**12b. DISTRIBUTION CODE** A
13. ABSTRACT *(Maximum 200 Words)* The Army is currently a party to scores of Energy Savings Performance Contracts (ESPCs). Under these ESPCs, contractors implement energy saving technology at Army facilities in return for a share of the annual dollar savings stream that the technology creates. Collectively, these ESPCs form the Army's Energy Saving Outsourcing Portfolio. In this analysis, we (a) determine if ESPC buyouts are economically attractive, (b) estimate funding level(s) needed for ESPC buyouts, and (c) compare the economic attractiveness of buying out ESPCs to that of investing in other energy saving opportunities. .			
14. SUBJECT TERMS Energy Savings Performance Contracts (ESPCs), portfolio analysis, cost-benefit analysis, opportunity cost, economic analysis, Army installations, base infrastructure, privatization, payback, energy conservation opportunities (ECO)			
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	**18. SECURITY CLASSIFICATION OF THIS PAGE** UNCLASSIFIED	**19. SECURITY CLASSIFICATION OF ABSTRACT** UNCLASSIFIED	**LIMITATION OF ABSTRACT** SAR

NSN 7540-01-280-5500
Standard Form 298

20020220 097

ANALYSIS OF ENERGY SAVING OUTSOURCING PORTFOLIO (AESOP)

SUMMARY

THE PROJECT PURPOSE was to determine from an economic perspective if it is in the Army's best interest to buy out any of its Energy Savings Performance Contracts (ESPCs). Under ESPCs, contractors implement energy saving technology at Army facilities in return for a share of the annual dollar savings stream that the technology creates.

THE PROJECT SPONSOR is the Director for Facilities and Housing of the Office of the Assistant Chief of Staff for Installation Management (ACSIM).

THE PROJECT OBJECTIVES were to (a) determine if ESPC buyouts are economically attractive, (b) estimate funding level(s) needed for ESPC buyouts, and (c) compare the economic attractiveness of buying out ESPCs to that of investing in other energy saving opportunities.

THE SCOPE OF THE PROJECT was as follows:

- The remaining lives of individual Army ESPCs considered in this study vary between 7 and 25 years, and the award dates vary from 1988 to 1999.
- All projects are viewed from a life cycle cost perspective.
- The vast majority of Army ESPCs are included in our portfolio of 52 ESPCs.

THE APPROACH was to determine the economic value of both ESPC buyouts and new energy conservation opportunity (ECO) investments and then perform a tradeoff analysis between the two portfolios in order either to (1) maximize the portfolio's return on investment by maximizing its savings to investment ratio (SIR) or (2) maximize the portfolio's liquidity by minimizing its payback (PB) period.

THE MAIN ASSUMPTION is that ESPC and ECO energy savings projections are accurate. These projections are the product of engineering estimates rather than an extrapolation of actual performance results or empirical data.

THE PRINCIPAL FINDING is that two-thirds of the Army's ESPCs are economically attractive buyout targets from both a savings to investment ratio and a payback period perspective. Buying out these ESPCs would require an investment of about $200 million (fiscal year (FY) 00$). However, with very few exception, new ECO investments appear to provide better economic value than ESPC buyouts.

THE PROJECT EFFORT was conducted by Mr. James Keller, Jr., Resource Analysis Division, Center for Army Analysis.

COMMENTS AND QUESTIONS may be sent to the Director, Center for Army Analysis, ATTN: CSCA-RA, 6001 Goethals Road, Suite 102, Fort Belvoir, VA 22060-5230.

CONTENTS

FIGURES

CHAPTER 1 INTRODUCTION

1.1 Analysis of Energy Saving Outsourcing Portfolio (AESOP)

The Army is currently a party to scores of Energy Savings Performance Contracts (ESPCs). Under these ESPCs, contractors implement energy saving technology at Army facilities in return for a share of the annual dollar savings stream that the technology creates. Collectively, these ESPCs form the Army's Energy Saving Outsourcing Portfolio. In this analysis, the relative utility of these performance contract vehicles vis-à-vis simple up-front investment in the same technologies is called into question, as well as the efficacy of buyouts to convert these performance contract vehicles into Army investments.

1.2 Purpose

The purpose of AESOP is to assess the costs and benefits of buying out a portion of the Army's ESPC portfolio and to estimate how much funding should be set aside (if appropriate) to buy out selected Army ESPCs.

1.3 Background

The Army recognized over a decade ago that through capital improvements and technology upgrades to its aging facilities, it could save more money on its energy bill than these improvements and upgrades would cost. Furthermore, it recognized that saving energy had the added environmental benefits of reducing hydrocarbon emissions and conserving natural resources. While these investments were attractive, they required an up-front investment that could only be recouped over a number of years, typically 10 to 20 years. Lacking the up-front funding necessary to reap the benefits of investing in these Energy Conservation Opportunities (ECOs), the Government devised a method of financing them through third-party commercial sources with a contract vehicle called an Energy Savings Performance Contract.

Under ESPCs, contractors rather than the Government must raise enough cash to make proposed capital improvements to Government facilities. They borrow these funds from commercial, third party sources. Under many ESPC agreements, they are also responsible for operation and maintenance. They are compensated for their capital investment, construction profit, interest expense, finance costs, and any operating and maintenance expenses and associated profit, by a series of regular Government payments over a specified period of time, usually around 15 years. Thus, an ESPC is a form of lease, at the end of which the Government owns capital improvements made by an ESPC contractor.

Unlike an ESPC contractor, the Government has no up-front capital investment expenses. And because ESPC payments to contractors are generated out of the Government's savings on its energy bilL--by law, payments may not exceed actual, or in some cases, stipulated savings--ESPCs have no negative impact on outyear budgets.

Another feature of ESPCs is that measured deviations in actual technological performance result in proportionally higher or lower payments to ESPC contractors. Thus, by providing greater energy efficiency, a contractor can increase his profits. Conversely, poor technological performance results in lower contractor profits. Because an ESPC is a performance-based contract, contractors are offered incentives to perform well.

In summary, ESPCs have three attractive qualities from an Army perspective:

1. No up-front capital outlay from the Government is required;

2. No negative impact on the outyear budget occurs;

3. Contractors are offered incentives to ensure that the energy savings materialize.

ESPC Buyouts

Contractually, the Army may terminate an ESPC by paying the contractor a sum of money stipulated in the ESPC. This sum is the remaining principal balance on the third party loan secured by the ESPC contractor, plus a loan prepayment penalty (typically around 3 percent). In some cases, there is an additional, though relatively small, penalty related to business expenses the contractor must incur to discontinue the contract. Terminating the ESPC in this way is known as termination for convenience, and it is the Government's right to do so if it chooses. Alternately, the Government could offer an ESPC contractor a lesser sum of money than that stipulated in the termination for convenience clause of the contract, but the contractor is not obligated to accept this lower offer.

One reason the Government might desire to terminate (buy out) an ESPC is that it would avoid any further interest expense associated with third party financing. Because a portion of each payment the Government makes to an ESPC contractor is to cover the contractor's interest expense on his third-party loan, the Government effectively incurs this interest expense each time it makes a payment. In terminating an ESPC, the Government provides the contractor the money to retire the third party loan principal, thereby freeing itself of any further obligation associated with the loan.

A second reason the Government might desire to terminate (buy out) an ESPC is to lay claim to any extraordinary energy savings it is generating due to technological efficiencies that exceed the baseline projections. When an ESPC is negotiated, a most likely case baseline is used to calculate what portion of savings is to be paid to the ESPC contractor during the life of the ESPC. A portion is chosen that is large enough to cover third party debt service (construction profit is rolled into the principal of this loan) and any other recurring contractor costs plus profit. Typically, this portion is around 90 percent. If the ESPC technology performs better than projected in the agreed upon baseline, then about 90 percent of the savings over baseline would belong to the contractor. (See the risk paragraph of this report for a discussion of baseline deviations resulting from factors other than technological efficiency). By buying out such an ESPC, the Government would receive all excess savings rather than just the remaining 10 percent. From this perspective, the better an ESPC's technological efficiency, the more

attractive it is as a buyout target. Conversely, if an ESPC's efficiency falls below baseline projections, it becomes a less attractive buyout target, unless the contractor is willing to accept a sum of money below that required for termination for convenience, which is based on baseline projections of efficiency.

Opportunity Cost

The Army has created an exhaustive compendium of potential ECOs for Army installations. It is called the Renewables and Energy Efficiency Planning (REEP) database. Every dollar that the Army invests in ESPC buyouts is a dollar that could have been spent on new ECOs. New ECO investment therefore is an opportunity cost of investing in ESPC buyouts. Like most ESPC buyouts, new ECO investments would provide a positive return on investment. Unlike ESPC buyouts, investment in these new ECOs would create additional energy savings and environmental benefits for the Army.

1.4 Essential Elements of Analysis (EEA)

Essential Elements of Analysis	Criteria / Metric
1. Who assumes the three principal sources of savings risk? a. Energy price (energy inflation rate) risk b. Usage risk c. Technological risk	Risk Matrix
2. Is an Army buyout of all or some of its ESPC portfolio economically attractive?	Net Present Value (NPV) > 0 Savings* to Investment Ratio (SIR) >1
3. How should the buyouts be prioritized?	SIR
4. Are there any ESPCs for which a buyout is economically unattractive?	NPV<0 SIR<1
5. What are the opportunity costs of buying out the ESPCs? Given these opportunity costs, is an Army buyout of all or some of its ESPC portfolio still economically attractive?	Investment Frontier
6. What could the "contingent liability" be for potential ESPC buyouts?	Termination Ceiling

* Savings reflect both cost savings and cost avoidance.

Figure 1. Essential Elements of Analysis

Figure 1 outlines the essential elements of our analysis and also serves as an outline for presenting our results.

The first essential element of analysis (EEA) addresses who (the Government or the ESPC contractor) assumes the various risks involved in ESPCs. This element is important because it reveals what risk the Government already bears as party to an ESPC and what risk it will assume in buying out an ESPC.

The second through fourth essential elements of analysis pertain to whether or not ESPC buyouts are economically attractive in and of themselves.

The fifth EEA pertains to whether or not ESPC buyouts remain attractive when we consider that new ECO investment in REEP projects will be forgone in order to buy out ESPCs (see Opportunity Cost, paragraph 2.3, for a brief discussion).

The last EEA helps the Army determine how much money should be allocated for ESPC buyouts. The answer to this question depends on whether the Army's goal is to maximize return on investment or maximize liquidity (minimize the time it takes to recoup any investment via cost savings/avoidance). It also depends on the level of savings desired.

CHAPTER 2 METHODOLOGY

2.1 General Approach

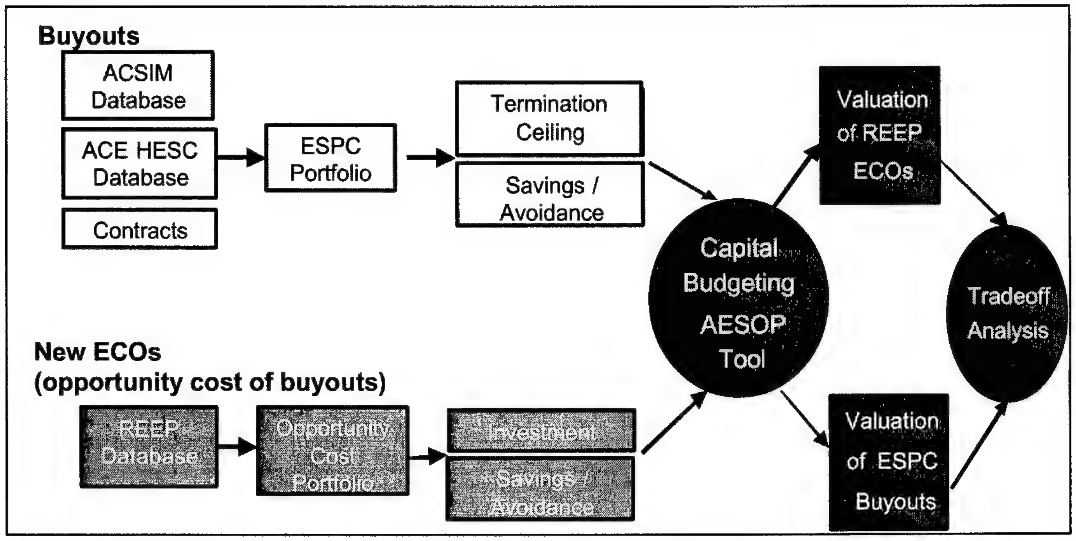


Figure 2. Analytical Approach

Figure 2 shows the framework of our analytical approach. Steps related to ESPCs are represented under the Buyouts notation while steps related to REEP ECOs are represented below the New ECOs notation. (Recall that REEP is used as our surrogate for new ECOs.) The AESOP Model generated for this analysis is represented at the right of the figure.

Our approach was to extract the appropriate data from various sources and process it with the AESOP Model. The AESOP Model:

1. Normalizes the data for inflation.

2. Fills in any missing parameters with sample averages from that portion of the portfolio for which those parameters are known

3. Analyzes the data for individual projects, whether they be ESPC buyouts or new ECOs, to calculate for each an economic value from a capital budgeting, present value perspective.

4. Executes optimization algorithms that rank order projects for maximizing either net present value or liquidity.

5. Performs tradeoff analysis by using the investment frontier concept and recognizing that not investing in new ECOs is the opportunity cost of investing in ESPC buyouts.

As mentioned in paragraph 2.2, the investment required for each ESPC buyout is assumed to be that ESPC's contract termination ceiling. The cost savings/avoidance for each ESPC buyout in the diagram above is the contractor's share, since the Army is already entitled to the Government's share prior to any buyout. Furthermore, the cost savings/avoidance for both ESPC buyouts and new ECOs is net of the cost of recurring functions such as operation and maintenance. This is so for ESPCs because the Army will continue to incur the cost of these recurring functions after any ESPC buyout, the same as it did prior to that buyout (see paragraph 2.2). This is so for ECOs because the cost of these recurring functions is a fact of life in the case of many new ECOs.

In essence, we determined the economic value of both ESPC buyouts and new ECO investment, and then performed a tradeoff analysis between the two portfolios in order to maximize either return on investment or liquidity.

2.2 Analysis Capability

CAA created a detailed database from ESPC contract archives by gathering insights into cost, technical, and risk areas via on-site interviews with Government contracting officers and through thorough discussions with technical experts who have extensive experience with ESPCs.

The result of our efforts is the AESOP Tool, which provides a capability to conduct economic tradeoff analyses between new ECOs and ESPC buyouts:

- Calculates key portfolio measures of efficiencies.
- Performs a variety of ranking algorithms.
- Executes capital budgeting calculations under a variety of economic conditions.
- Calculates termination liability via amortization and penalty algorithms.
- Allows operation and maintenance (O&M) cost to be modeled a variety of ways.
- Fleshes out underlying data via statistical sampling techniques.
- Incorporates the REEP database, allowing opportunity cost to be modeled for a variety of economic and programmatic conditions.

2.3 Scope

This analysis is limited to the Army's active ESPC portfolio and its new ECOs portfolio. The remaining lives of individual Army ESPCs considered in this study vary between 7 and 25 years, and the award dates vary from 1988 to 1999.

All projects are viewed from a life cycle cost perspective to ensure that we have a thorough, comprehensive view of costs and cost savings/avoidance. However, because nothing the Army

does now can change the past, sunk costs are ignored. For example, past Army payments to ESPC contractors are ignored, while remaining, future payments heavily impact our analysis.

We were unable to gather sufficient information on at least three ESPCs to include them in our study. Furthermore, we omitted several very small ESPCs because their collective investment value represents only a small portion of the Army's total portfolio, probably less than 5 percent, and the time that would be required to analyze them would be disproportionately large in comparison to the benefit received. Nevertheless, we believe that the vast majority of Army ESPCs (as measured by investment and savings dollars) are included in our portfolio of 52 ESPCs.

Parameters of Analysis

- The contract values of the key ESPC parameters in our analysis (e.g., annual cost savings/avoidance, construction cost, contract life in years) were available for the entire portfolio of 52 ESPCs.
- The contract values for several other parameters (e.g., finance rates, energy price inflation rates, operation and maintenance price inflation rates, ESPC operation and maintenance costs) were unavailable for about half of our ESPC portfolio and had to be estimated from that half of the portfolio for which these values were known. In that half of the portfolio for which these values were known, these parameters displayed an extremely small variance (as measured by their standard deviation and coefficient of variance).
- For consistency, energy price inflation rates and operation and maintenance price inflation rates for new ECOs (REEP) were also estimated from the ESPC portfolio.

2.4 Key Assumptions

The key assumptions are that:

1. The data sources are accurate.
2. ESPC buyouts would occur in the current fiscal year (FY 00).
3. Termination ceilings are good estimators of the costs of ESPC buyouts.
4. ECOs that are untapped to date (new ECOs) are found in the REEP database.
5. Any recurring cost associated with an ESPC, e.g., operating and maintenance costs, will continue to be incurred by the Army after an ESPC buyout.
6. Partial buyouts are possible.

Each is addressed in order in the following paragraphs.

Our first key assumption is that our data sources are accurate. The data for this analysis was provided by the Assistant Chief of Staff for Installation Management (ACSIM) database and the Huntsville Engineering Support Center (HESC) database. Additionally, we collected data from

25 ESPC contracts, many of which were not in either the ACSIM or HESC databases. The data may not be accurate for three reasons. First, data entry errors may have occurred when the data was transferred from contract documents to the respective databases. Second, much of the data comes from engineering cost estimates and economic forecasts made during contract negotiation, which may or may not be accurate. Third, an ESPC's actual technical performance will either exceed or fall short of baseline projections. Examples of the types of data contained in our databases are:

- The capital investment cost and schedule for ESPC design, material acquisition, construction, installation, etc.
- The cost savings/avoidance generated by individual ESPCs (and implicitly, the associated technical performance baseline).
- The period of performance for individual ESPCs, in other words, the time span over which a contractor services an ESPC and shares in the savings it generates.
- Finance charges, interest rates, operation and maintenance cost inflation rates, and energy price inflation rates.

See Appendix C for a table of the data used in this report.

Our second key assumption is that ESPC buyouts will occur in the current fiscal year (FY 00). Alternately, we could have assumed that ESPC buyouts would be staggered over several years, but this would significantly increase the complexity of our analysis without much value added for a decision maker concerned with the current budget years. Furthermore, it would require additional assumptions to be made about the nature of any new ESPC agreements that the Army will certainly enter into over the staggered buyout period.

Our third key assumption is that the buyout costs are equal to contract termination ceilings. Buyout termination ceilings are contractually set to the third party loan principal payoff amount, which is the amount a contractor would have to pay his lender in order to be free of the debt he has incurred as a consequence of providing energy saving technology to the Army. It includes the amortized loan principal plus any prepay penalty. In our judgment, it is the ***minimum*** a contractor is likely to accept in a buyout if the ESPC is performing as well or better than the baseline projection; anything less would put the contractor in a negative cash flow position. Conversely, the termination ceiling is the maximum amount that the Government is legally obliged to pay an ESPC contractor in order to cancel an ESPC for convenience. Therefore, because termination ceilings represent both the most that the Government is obliged to pay and the least that contractors are likely to accept for a buyout, termination ceilings are good estimators of buyout costs.

Our fourth key assumption is that REEP contains all the Army's untapped ECOs. However, because we recognize that the Army has invested in REEP ECOs since the REEP database was assembled back in FY 96, we have further assumed that the Army's energy conservation expenditures from FY 96 to FY 99 were invested in the most profitable ECOs found in REEP and have removed them from the REEP database. The Army spent $155M (then-year dollars) on

energy conservation from FY 96 to FY 99, 18 percent of that required to harvest every ECO in REEP.

Our fifth key assumption is that any recurring cost associated with an ESPC, e.g., operating and maintenance costs, will continue to be incurred by the Army after an ESPC buyout and that the recurring cost will be equal to the recurring cost projection negotiated in the ESPC. Implicit in this assumption is that (1) recurring costs are a fact of life and must be either borne by the Army or contracted out in the event of a buyout, (2) the Army or any contractor performing the functions associated with these recurring costs will be no more and no less efficient than the original ESPC contractor, and (3) ESPC cost projections for recurring costs are accurate.

Our sixth key assumption, that partial buyouts are possible, means that we assume that if funding is not available to entirely buy out an ESPC, then some portion of that ESPC can instead be bought out, and the benefit (or detriment) to the Army of this partial buyout is proportional to the ratio between the cost of this partial buyout and the cost of a full buyout.

2.5 Limitations

Our database consists of negotiated engineering estimates for ESPCs and modeled engineering estimates for new ECOs (found in REEP). In contrast to REEP, which is not based on empirical data, ESPCs have received scrutiny from both Government and private industry experts of a sufficient degree to make a mutual, contractual obligation possible. Therefore, the ESPC database likely possesses greater fidelity than the REEP database. Neither represents actual performance data.

Though we were unable to gather all the Army's ESPCs for our portfolio, we are confident we have the vast majority, and certainly enough to make the analysis relevant. Required data for analysis was not available for at least three ESPCs (Picatinny Arsenal, NJ; West Point, NY; and, Fort Polk, LA). Some recently awarded ESPCs also were not included.

2.6 Economic Costs and Benefits of ESPC Buyouts

This paragraph addresses the second through fourth essential elements of analysis, which pertain to whether or not ESPC buyouts are economically attractive in and of themselves. To make this determination, we employed two metrics, (1) net present value (NPV) and (2) savings to investment ratio (SIR). After first defining these metrics, we will address essential elements of analysis two through four.

Net Present Value

Economic theory provides us with a metric for measuring the economic value of an investment. It is called net present value. NPV is a profitability metric that, after accounting for the time value of money, measures the extent to which the cash inflows of an investment exceed the cash outflows. In the case of ESPC buyouts, the cash inflows of our NPV calculation are the contractor's share of ESPC cost savings/avoidance (less any operating and maintenance expense that the Government must assume from the contractor after buyout). Restated differently, the cash inflows of our NPV calculation are the payments that Government avoids by buying out an ESPC (net of any costs that the Government must assume to operate and maintain any ESPC technology). The cash outflows of our NPV calculation constitute the investment required to buy out an ESPC, assumed in this analysis to be the contract termination ceiling (see paragraph 2.2).

In calculating NPV, one must adjust for the time value of money because a dollar received today is worth more than a dollar received tomorrow. Computationally, the time value of money is incorporated by applying discount rate factors to cash inflows and outflows, effectively reducing the size of cash inflows and outflows more the further they occur in the future, and less the closer they occur to the present. Per Office of Management and Budget (OMB) Circular A-94, the Center for Army Analysis (CAA) used the discount rate prescribed by OMB for a project with a life of 10 to 30 years. The rate OMB publishes is the risk free discount rate, which can be defined for all practical purposes as interest rate of a US Treasury note or bond with the same life as the investment in question.

(All dollars are discount rate adjusted)

+ Contractor's Share of Remaining Life Cycle Cost Savings/Avoidance

- Operation & Maintenance Cost Assumed by the Government

- Buyout Cost (Termination Ceiling)

= NPV of Buyout

Savings to Investment Ratio

While NPV is an absolute measure of the economic value of an investment, it provides no insight into the efficiency of an investment. To measure investment efficiency, sometimes called return on investment or "bang for the buck," we utilized a metric called the savings to investment ratio. SIR is the ratio of net savings to investment. For ESPC buyouts, net savings are the sum of all future payments due the ESPC contractor, less any operating and maintenance cost that must be assumed by the Government in the event of a buyout. The investment for an ESPC buyout is the buyout cost or contract termination cost - the sum of money that the Government must pay the contractor in order to terminate the contract.

(All dollars are discount rate adjusted)

$$\textit{SIR of Buyout} = \frac{\textit{(Cont'r Share of Remaining LCC Sav/Avoid – O\&M Assumed by the Gov't)}}{\textit{Buyout Cost}}$$

Economic Attractiveness

If an investment provides greater discount rate adjusted cash inflow than outflow, then it is economically attractive. It will have an NPV greater than 0 and a SIR greater than 1. Conversely, if an investment provides less discount rate adjusted cash inflow than outflow, then it is economically unattractive and will have a NPV less than 0 and a SIR less than 1. We calculated the NPV and SIR associated with a buyout of each ESPC in our portfolio. These NPV and SIR values are shown in Appendix C. Roughly two-thirds of the ESPCs in the portfolio are economically attractive buyout targets, with NPVs greater than 0 and SIRs greater than 1. The remaining third are not economically attractive buyout targets.

Prioritizing ESPC Buyouts

Having addressed our analytical method of determining whether ESPC buyouts are economically attractive or not, we now turn our attention to how buyouts should be prioritized. ESPC buyouts should be prioritized to maximize their benefit to the Army. In this study, we focus on the economic benefit the Army receives from ESPC buyouts. The way for the Army to maximize the economic benefit it receives from ESPC buyouts is for it to maximize the cumulative NPV it achieves from the buyouts it can afford. This can be achieved by prioritizing ESPC buyouts according to their SIR. The ESPC buyout with the largest SIR ratio is chosen first, that with the second largest SIR is chosen second, and so on, until the cumulative investment required matches the funding available. (In order to exactly match the funding constraint, the last buyout chosen may be a partial buyout).

2.7 Opportunity Costs of ESPC Buyouts

The term "opportunity cost" refers to the amount of benefit that must be forgone or sacrificed in order to reap the benefits of a particular investment or course of action. When choosing between two courses of action, the opportunity cost is the unrealized benefit of that course of action not chosen. An opportunity cost associated with any Government expenditure is the benefit the Government could receive by paying down its debt. This opportunity cost is the "cost of money." We have already accounted for the cost of money associated with ESPC buyouts by employing discount rates in calculating the NPVs and SIRs. In this paragraph, we consider opportunity costs of ESPC buyouts that are above and beyond the cost of money: the cost of not investing in new ECOs.

As discussed in the background paragraph of this study, paragraph 1.3, every dollar that the Army invests in ESPC buyouts is a dollar that could have been spent on new ECOs. The unrealized benefits of new ECO investment are therefore an opportunity cost of investing in ESPC buyouts. This study attempts to quantify this opportunity cost by calculating the NPV for the new ECO investments available to the Army (as represented in REEP). This study does not capture forgone societal benefits such as energy usage and pollution reduction, even though these opportunity costs are most certainly associated with ESPC buyouts.

The opportunity cost of investing in ESPC buyouts depends on the level of investment employed. Obviously, at higher levels of investment in ESPC buyouts, more new ECOs are forgone than at lower levels of investment. Therefore, in order to measure the opportunity cost of investing in ESPC buyouts, the level of investment must be specified. This chosen level of investment, then, is the parameter by which we normalize forgone benefits for comparison to the expected benefits associated with ESPC buyouts.

At a chosen level of investment, the opportunity costs of ESPC buyouts can be measured by summing the NPV of the best forgone ECOs. As discussed earlier, the best ECOs from an economic standpoint are those with the highest SIRs. Therefore, that ECO with the highest SIR is selected first, then that with the second highest SIR, on so on, until the chosen investment level is reached. (In order to exactly match the chosen investment level, it may be necessary to undertake only a portion of the last ECO). The total NPV of the ECOs selected in this manner represents the opportunity cost associated with buying out ESPCs rather than investing in said ECOs.

Pure Investment Strategies

Thus far in this paragraph, the discussion has centered on two investment alternatives: (1) invest at a specified level in ESPC buyouts or (2) invest at a specified level in new ECOs. These are pure investment strategies. Figure 3 illustrates these two pure investment strategies.

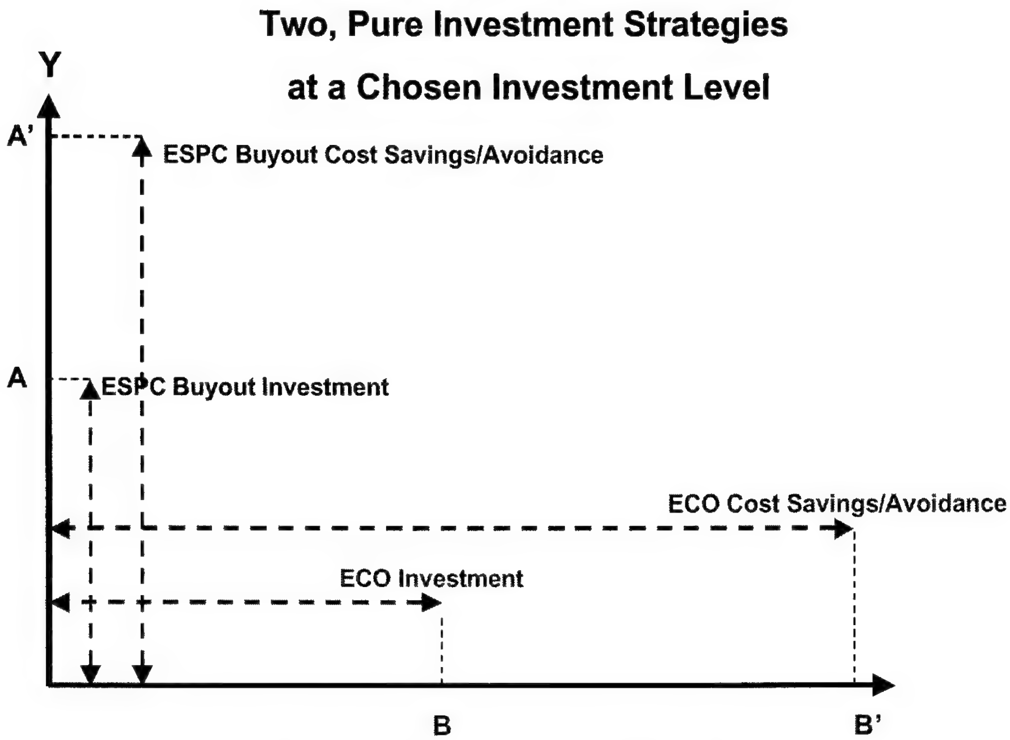


Figure 3. Pure Investment Strategies

Figure 3 shows that by investing *A* dollars in ESPC buyouts, A' dollars are saved. This constitutes a pure investment strategy in ESPC buyouts. Alternately, by investing *B* dollars in new ECOs, *B*' dollars are saved. This constitutes a pure investment strategy in new ECOs. Given that *A* equals *B*, then the opportunity cost of a pure investment strategy in ESPC buyouts, which yields A' dollars in savings, is a pure investment strategy in new ECOs, which yields *B*' dollars in savings. Furthermore, because *A'* is unlikely to equal *B'*, one of the pure investment strategies provides a greater economic benefit than the other, even though both provide a positive NPV.

Mixed Investment Strategy

We now consider a third investment alternative--investing in both ESPC buyouts and new ECOs simultaneously. As before, investment is limited to some chosen level. However, unlike before, the Army may apportion its investment between ESPC buyouts and new ECOs.

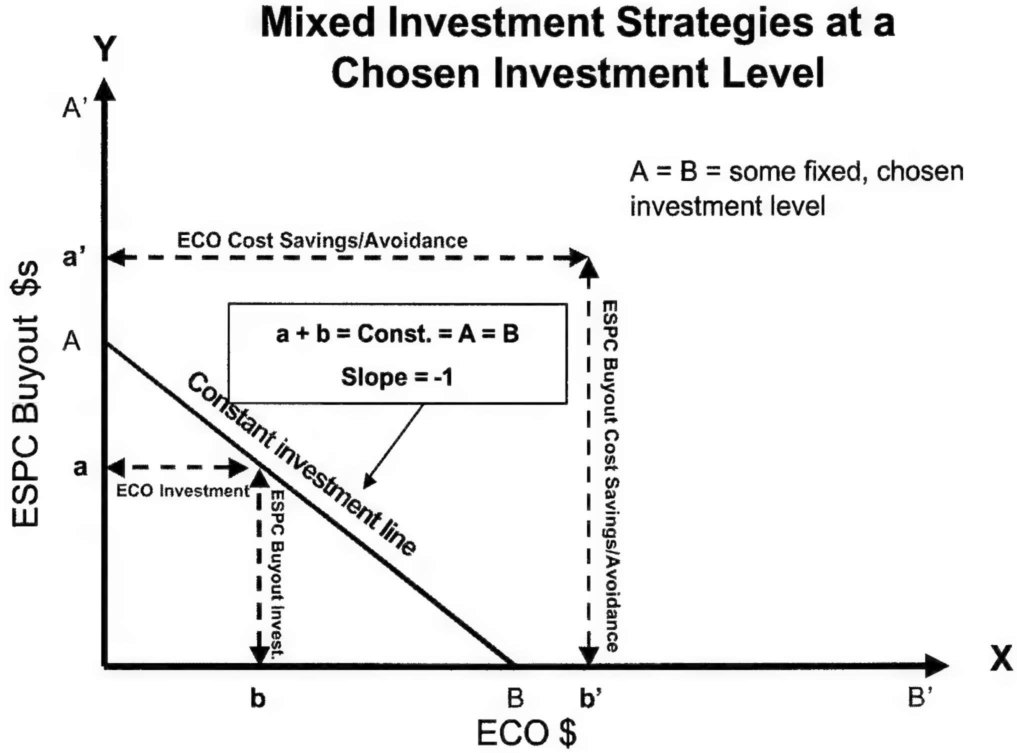


Figure 4. Mixed Investment Strategies

To the previous chart (Figure 3) we add a constant investment line (line A-B) on which every possible apportionment between ESPC buyouts and new ECOs of a chosen investment amount may be found, as shown in Figure 4. Because the magnitude of *A* exactly equals the magnitude of *B*, the slope of the constant investment line is negative one. Furthermore, at every point on this line, x plus y equals the chosen investment amount (which has a magnitude *A*). For instance, investment may be apportioned so that *a* dollars are invested in ESPC buyouts and *b* dollars are invested in new ECOs. Under this mixed investment strategy, less money would be invested in ESPC buyouts than it would under a pure strategy of investing in ESPC buyouts (*a* is less than *A*). Less money would also be invested in new ECOs than it would under a pure strategy of investing in new ECOs (*b* is less than *B*). Nevertheless, the total investment (*a* plus *b*) is equal in magnitude to the total investment under a pure strategy of investing only in ESPC buyouts (because $A = a + b$), and it is also equal in magnitude to the total investment under a pure strategy of investing only in new ECOs (because $B = a + b$).

For every point on the constant investment line, there exists some other point that represents the most efficient cost savings/avoidance that can be generated by that investment. For the investment represented by ordered pair (a,b), the associated savings are represented by ordered pair (a',b'). If each efficient savings point associated with the points on the constant investments line is graphed, the result is the curve on Figure 5 labeled "savings." Because these "savings" (cost savings/avoidance) are the most that can be achieved for each point on the constant investment line, the "savings" curve forms a boundary that is the upper limit on the benefit possible from investing *A* dollars in ESPC buyouts and new ECOs. This "savings" curve

represents the efficient trade space for apportioning a chosen level of investment. Because any point to the right or above the "savings" curve is not achievable, Figure 5 is known as the investment frontier. An investment frontier is a curve, which shows the savings combinations achievable through the apportionment of a fixed budget between two competing investment classes, in this case, ESPC buyouts and new ECOs.

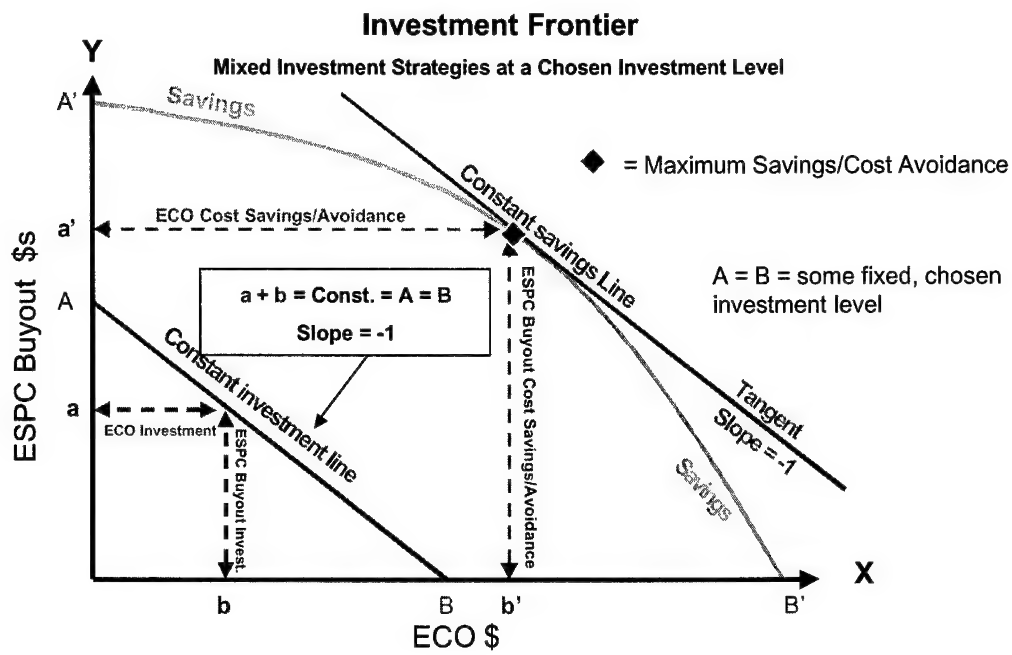


Figure 5. Investment Frontier

The maximum savings that can be achieved by a mixed investment strategy is found at the point on the savings line that is intersected by a tangent line with a slope of negative one. Along this tangent line, the total savings level, $x + y$, is constant. Furthermore, the total savings represented by the tangent line are superior to those found on the "savings" curve at every point but the point of tangency. At this point, economic benefit is maximized and opportunity cost is minimized, ensuring that expected economic benefits exceed forgone economic benefits by the maximum extent possible.

2.8 Contingent Liability for ESPC Buyouts

The contingent liability (the amount of funds programmed to cover an anticipated expenditure of uncertain magnitude) for ESPC buyout investment cannot exceed the total investment level needed to buyout the Army's entire ESPC portfolio, about \$290M (FY 00\$). Moreover, it should not exceed the investment level required to buy out all ESPCs that have positive NPVs

and favorable payback periods, about $200M (FY 00$). To determine exactly what the contingent liability for ESPC buyouts should be, some cutoff value for SIR or payback period must first be specified. The results portion of this study provides tables and graphs from which contingent liabilities can be determined for various SIR and payback period cutoff levels. These charts and graphs are achieved by rank ordering the individual ESPC projects according to their SIRs and payback periods and providing a running, cumulative total for the associated required investment.

CHAPTER 3 RESULTS

3.1 Introduction

The results of our analysis are arranged in the same order as the EEAs of Figure 1 (duplicated below). Figure 1 serves as an outline for this chapter.

Essential Elements of Analysis	Criteria / Metric
1. Who assumes the three principal sources of savings risk? a. Energy price (energy inflation rate) risk b. Usage risk c. Technological risk	Risk Matrix
2. Is an Army buyout of all or some of its ESPC portfolio economically attractive?	Net Present Value (NPV) > 0 Savings* to Investment Ratio (SIR) >1
3. How should the buyouts be prioritized?	SIR
4. Are there any ESPCs for which a buyout is economically unattractive?	NPV<0 SIR<1
5. What are the opportunity costs of buying out the ESPCs? Given these opportunity costs, is an Army buyout of all or some of its ESPC portfolio still economically attractive?	Investment Frontier
6. What could the "contingent liability" be for potential ESPC buyouts?	Termination Ceiling

* Savings reflect both cost savings and cost avoidance.

3.2 Risk

This paragraph addresses the first EEA depicted in Figure 1. It addresses who (the Government or the ESPC contractor) assumes the various risks involved in ESPCs. This element is important because it reveals what risk the Government already bears as party to an ESPC and what risk it will assume in buying out an ESPC. It is important to recognize that the bearer of risk may either benefit from it or be hurt by it. Stated differently, the assumption of risk has a potential upside as well as a potential downside for the bearer. The purpose of this paragraph is to isolate the only area of risk impacted by ESPC buyouts, and to dispel what is perhaps a common misconception, that ESPC contractors stand to make huge profits if energy prices rise sharply.

The three principal sources of risk associated with ESPCs are:

1. Energy price inflation risk - the risk that actual energy prices will deviate from those projected and stipulated to in an ESPC agreement (e.g., oil prices rise faster than expected);

2. Energy usage rate risk – the risk that actual energy usage will deviate from that projected and stipulated to in an ESPC agreement (e.g., energy usage rates fall because barracks are left vacant when a division is sent abroad on a peacekeeping mission);

3. Technological performance risk - the risk that actual energy efficiency improvements will deviate from those projected in an ESPC agreement (e.g., a heating and air conditioning system does not reduce expended BTUs to the extent agreed upon);

All three areas of risk have one thing in common: they all impact the level of cost savings/ avoidance the Government actually realizes from an ESPC.

To understand the potential impacts of these risks and who bears them, we must first understand how they affect Government payments to ESPC contractors. Recall that an ESPC contractor is entitled to a percentage of the Government's cost savings/avoidance. In negotiating an ESPC, the Government and the contractor agree to a baseline projection of costs and cost savings/ avoidance. Explicit in that baseline are energy price inflation projections, energy usage rate projections, and technological performance (improved energy efficiency) projections. Of these, the first two are stipulated to in the agreement for contractor payment purposes. That is, for contractor payment purposes, the energy inflation and usage rate projections in the ESPC baseline are used to calculate Government cost savings/avoidance, regardless of how inaccurate those projections turn out to be. And since the payment a contractor receives is proportional to the Government's cost saving/investment when it is calculated in this way, a contractor's revenue is unaffected by energy inflation rate and usage rate deviations from baseline. Thus, the Government bears the full burden of energy usage rate risk and energy inflation rate risk in both the presence and absence of an ESPC. An ESPC buyout does not relieve the Government of the burden of either or these forms of risk. Neither do ESPC contractors stand to make huge profits if energy prices rise sharply, nor experience huge losses if energy prices fall sharply.

On the other hand, technological performance is not stipulated to in ESPCs and is subject to verification and validation. In many ESPCs, energy efficiency is measured periodically. Unfavorable deviations result in lower payments to and profits for contractors, while favorable deviations result in higher payments to and profits for the contractors. Because an ESPC contractor's share of cost savings/avoidance is typically around 90 percent, he bears the vast majority of technological performance risk under an ESPC. If the Government buys out an ESPC that is subject to performance monitoring, it assumes the technological performance risk and is no longer insulated from unrealized savings from poorly performing ESPC technology.

Under many ESPC agreements (perhaps the majority), the Government has determined that the cost of monitoring technological performance exceeds the potential benefits. For all practical purposes, contract baseline projections of technological performance are stipulated to in these instances, and the Government bears the associated risk whether there is an ESPC buyout or not.

In summary, if an ESPC's technological performance exactly meets expectations:

- A contractor is entitled to payments based on the projected energy prices and usage rates in the ESPC agreement.
- A contractor is not entitled to higher payments, even if sharp increases in energy prices cause actual Government cost savings/avoidance to far exceed ESPC baseline projections.
- A contractor is not subject to lower payments if energy price inflation is lower than projected in the ESPC.
- Contractor payments are unaffected by deviations in actual usage rates.

In essence, if technological performance meets expectations, then the ESPC contractor payment schedule is virtually written in stone. However, if savings do not materialize because an ESPC's technology is not as efficient as promised, or because the contractor does not maintain or operate the technology as promised, then the contractor is entitled only to a reduced payment amount. Conversely, unforeseen fluctuations in energy prices and facility usage have no effect on the payment to which an ESPC contractor is entitled.

The Risk Matrix

The matrix shown in Figure 6 depicts the results of our examination of the risks associated with ESPC buyouts (EEA 1). It shows that only technological and performance risk change as a result of ESPC buyouts. It also shows that ESPC buyouts and new ECOs both entail the same types of risks to the Government.

Risk Source	ESPC Risk Bearer		ESPC Buyout or New ECO Risk Bearer	
	Gov't	Cont'r	Gov't	Cont'r
Energy price (energy inflation rate) risk	X		X	
Usage risk	X		X	
Technological & performance risk		X	X	

Figure 6. Risk Matrix

The implications of the risk matrix shown above can be seen in Figure 7.

Risk	Condition	General Impact	
		Gov't Savings	Payments to Contractor
Energy Price Inflation	Higher than ESPC projections	Higher than ESPC projections	Unchanged
	Lower than ESPC projections	Lower than ESPC projections	Unchanged
Facility Usage Rates	Higher than ESPC projections	Higher than ESPC projections	Unchanged
	Lower than ESPC projections	Lower than ESPC projections	Unchanged
ESPC Technological Performance	Higher than ESPC projections	Higher than ESPC projections	Increased
	Lower than ESPC projections	Lower than ESPC projections	Decreased

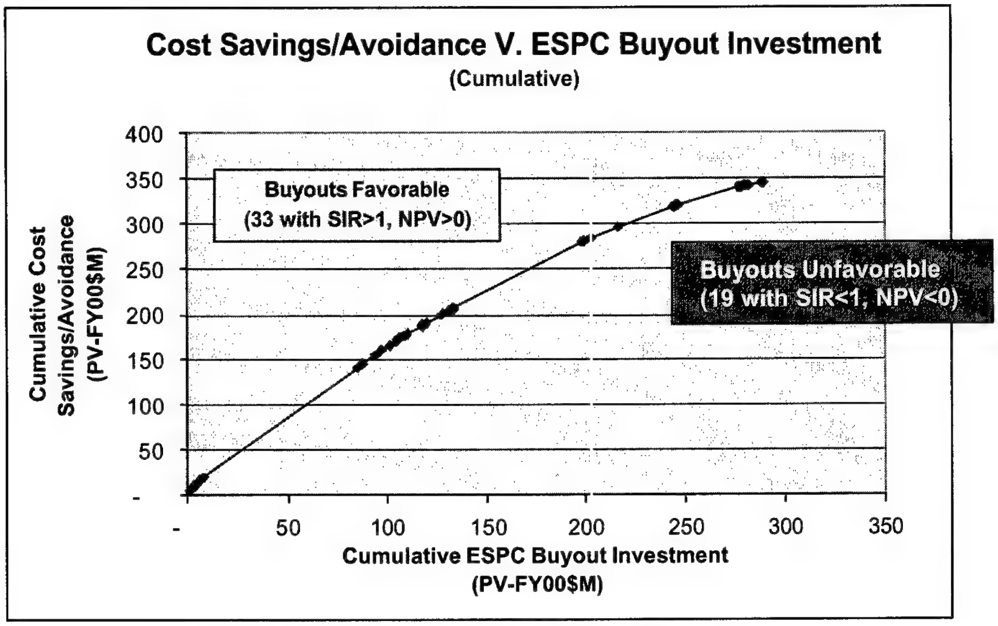
Figure 7. Implications of Risk Matrix

3.3 ESPC Buyouts Prioritized by SIR

The ESPC buyout with the largest SIR ratio is chosen first, that with the second largest SIR is chosen second, and so on. Because ESPC buyouts are added in order of declining SIR, the marginal return on investment diminishes as investment increases. Marginal profitability falls with the addition of each ESPC buyout until the slope of the curve, which is in fact the SIR, falls below unity. At this point on the curve, depicted by the intersection of the curve and the vertical line, adding an ESPC buyout worsens the outcome (NPV) because the additional investment is not fully recouped in the form of cost savings/avoidance. Therefore, ESPC buyouts to the right of the yellow line should not be undertaken.

Results

ESPC Buyouts Prioritized by SIR



Slope = SIR; if Slope<1, then buyout is unfavorable

Figure 8. ESP Buyouts Prioritized by SIR

Figure 8 is a graphical representation of some of the results of our analysis. It depicts a cumulative net savings versus investment curve for our ESPC buyout prospects, i.e., our ESPC portfolio. This figure addresses the central questions of this study.

- With respect to EEA 2 – "Are buyouts economically attractive?" – the figure shows that two-thirds of the ESPC portfolio are economically attractive buyout targets.

- With respect to EEA 3 – "How should ESPC buyouts be prioritized?" – the figure shows that it is best to prioritize the ESPCs by SIR if you want to maximize profitability of your investment.

- With respect to EEA 4 – "Are there any ESPCs for which a buyout is economically unattractive" – the figure shows that ESPC buyouts to the right of the vertical line are economically unattractive.

3.4 Opportunity Costs of Buying Out ESPCs

Results

New ECOs and ESPCs Prioritized by SIR

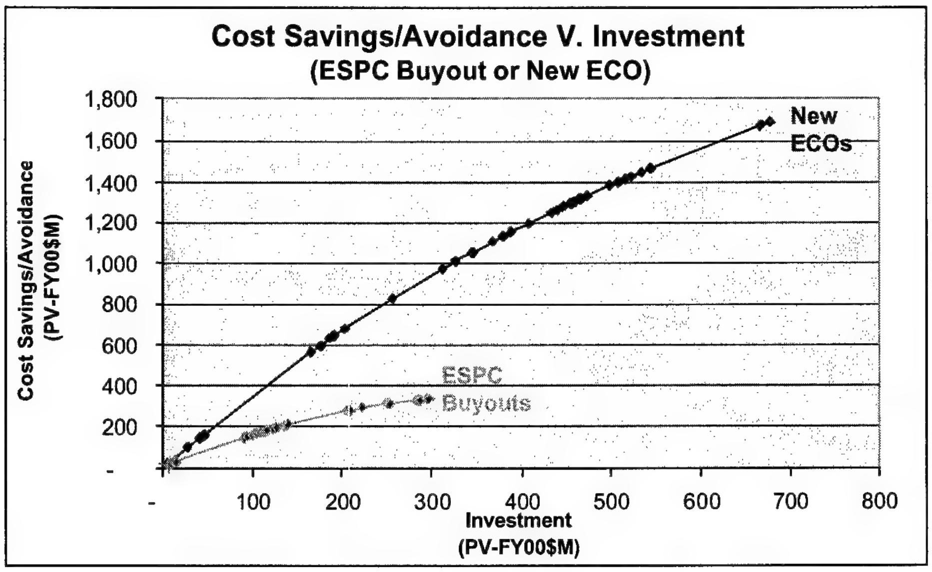


Figure 9. New ECOs and ESPCs Prioritized by SIR

In this and the next paragraph, we address EEA 5 in order to answer the question, "What are the opportunity costs of buying out the ESPCs?" Figure 9 shows the opportunity cost of ESPC buyouts. Because the Army must forgo new ECO investment in order to buy out ESPCs, the new ECO curve is the opportunity cost of investing in ESPC buyouts. Note once more that the curves reflect only economic costs and benefits; they ignore politics, color of money issues, etc. The curves reveal that a pure strategy of investing in new ECOs yields a greater return than a pure strategy of investing in ESPC buyouts.

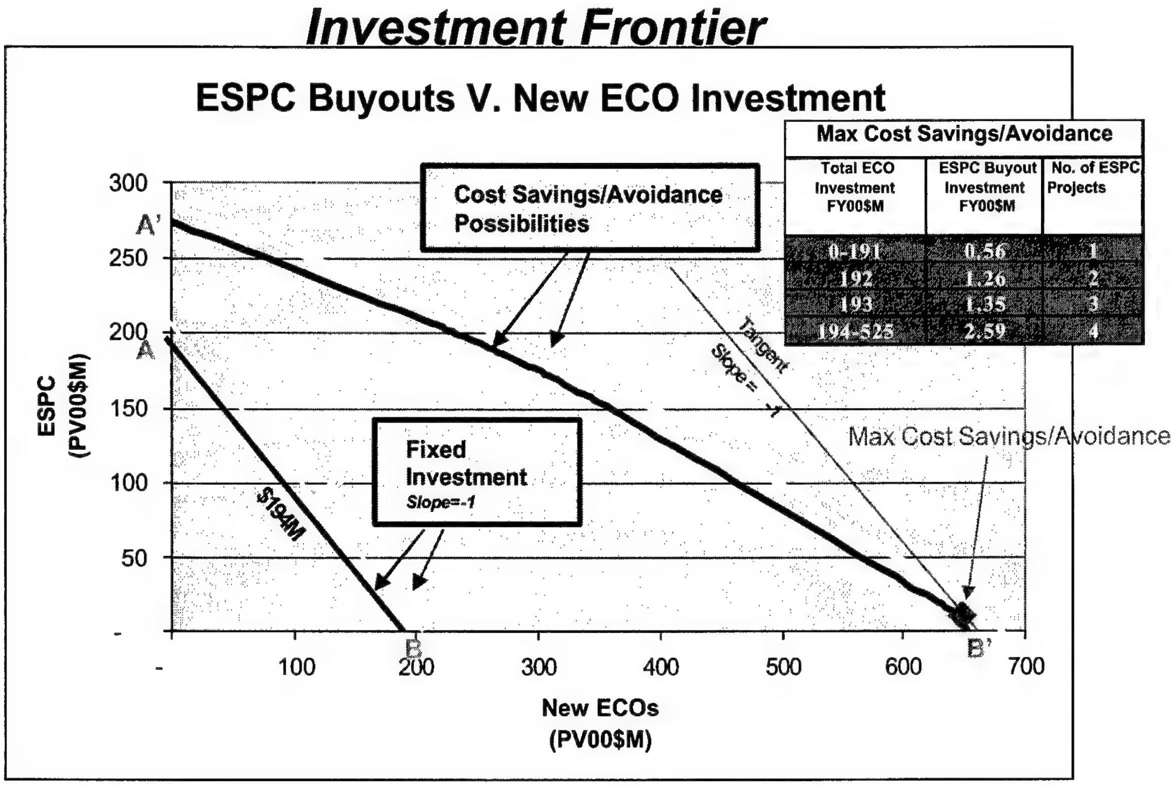


Figure 10. ESPC Buyouts versus New ECO Investment

While Figure 9 (previous figure) clearly reveals that a pure strategy of investing in new ECOs would yield a greater return than would a pure strategy of investing in ESPC buyouts, it reveals little about the level of ESPC buyout investment the Army would undertake if it chose to employ a mixed investment strategy (see paragraph 2.7 for a discussion of pure and mixed investment strategies). Figure 9 (previous figure) addresses opportunity under a mixed investment strategy. It addresses the questions posed in EEA 5:

(1) What are the opportunity costs of buying out the ESPCs?

(2) Given these opportunity costs, is an Army buyout of all or some of its ESPC portfolio still economically attractive?

Figure 10 above is populated with the results generated by the AESOP Model. It is an investment frontier, a curve that shows the savings combinations achievable through the apportionment of a fixed budget between two competing investment classes, in this case, ESPC buyouts and new ECOs (see paragraph 2.7 for greater detail). In Figure 10, the two "cost savings/avoidance possibilities" curves represent the efficient trade space associated with two fixed investment levels, $194M and $203M. Profitability is maximized on these two curves at the point of tangency with a line whose slope is negative one. Figure 10 also reveals that in

order to maximize profitability on either of these curves, the Army's investment apportionment would be heavily weighted towards new ECOs and away from ESPC buyouts.

The "Max Cost Savings/Avoidance" table in Figure 10 reveals that, under a mixed investment strategy of maximizing profitability, the Army would have to invest $193M in new ECOs before the level of investment in ESPC buyouts reached a mere $1.35M. Similarly, the Army could invest $525M in new ECOs, and the level of investment in ESPC buyouts would only be $2.59M.

3.5 Contingent Liability for ESPC Buyouts

What could the "contingent liability" (the amount of funds programmed to cover an anticipated expenditure of uncertain magnitude) be for potential ESPC buyouts? The criteria/metric we used to answer this question was the Termination Ceiling of the ESPC contracts.

Contingent Liability for ESPC Buyouts
Prioritized by SIR (Top 19)

Installation	ESPC Description/ECO Type	Contractor	SIR	NPV (PV-FY00$M)	Payback Period (Yrs)	ESPC Buyout Cost (PV-FY00$M)	Contingent Liability Cum. ESPC Buyout Cost (PV-FY00$M)	Net Cost Sav./Avoid. (PV-FY00$M)	Cum Net Cost Sav./Avoid. (PV-FY00$M)
Corpus Christi Army Depot	Chiller Replacement	Sempra Energy Serv. (CES/Way)	7.12	3.4	1	0.56	0.56	4.00	4.00
Ft. Stewart Air Propane Plant	Air Propane Tank	Sempra Energy Serv. (CES/Way)	2.97	1.4	2	0.70	1.26	2.07	6.07
Walter Reed AMC, DC/MD	Lighting, Motors, Insulation		2.86	0.2	5	0.09	1.35	0.25	6.32
Walter Reed AMC, DC/MD	Boiler replacement, Lighting, EMS, VSD, NG Water Heaters, High-efficiency A/C Units, Deaerator tank		2.81	2.3	5	1.25	2.59	3.50	9.82
Ft Carson, CO	Chiller Replacement	CES Way Int'l	1.83	0.6	6	0.72	3.31	1.32	11.14
Ft. McPherson/Gillem Air Propane Plant	Air Propane Tank	Systems Corp	1.68	1.75	4	2.56	5.88	4.31	15.45
Ft Dix, Barnes Fed Bdg, DACA87-96-F-0004	Lighting, Chiller Pumps, Damper Replacement,Toilets	Noresco	1.62	1.1	8	1.83	7.71	2.97	18.42
Fts Belvoir/McNair/Meade/ Myer/A.P. Hill	Lighting, EMCS, VFDs, Centralized Cooling, Geothermal Heat Pumps, VAV conversions, Boiler replacements, absorption chiller		1.59	45.0	8	76.45	84.16	121.41	139.83
West Point, Contract DACA87-96-D-0005	Lighting, Cooling Tower	Noresco	1.58	1.7	5	2.96	87.12	4.68	144.50
Ft Bragg, Simmons AF Hangar	Lighting, Boilers, Natural Gas	Honeywell	1.55	3.4	9	6.17	93.29	9.59	154.09
Ft Stewart, DACA87-97-D-0015	Lighting	ERI Services Inc	1.51	0.9	6	1.68	94.98	2.54	156.63
Walter Reed AMC, DC/MD	Lighting, Motors, Steam traps, Water valves/meters		1.48	0.9	7	1.76	96.74	2.62	159.24
Ft Bragg, Simmons AF Bdg	Lighting	Honeywell	1.47	0.1	9	0.21	96.95	0.31	159.56
Ft Leonard Wood, MO	Air Cooled Condensing Units & Evaporators	Sempra Energy Serv.	1.45	1.6	8	3.59	100.54	5.19	164.75
Walter Reed AMC, DC/MD	Chiller Replacement, controls & plant upgrade		1.43	1.5	9	3.55	104.08	5.08	169.82
Ft Stewart, DACA87-97-D-0015	Lighting II	ERI Services Inc	1.40	0.4	7	0.95	105.03	1.32	171.15
Blanchfield Army Community Hospital			1.39	0.3	7	0.73	105.76	1.01	172.16
Ft Dix, Barnes Fed Bdg, DACA87-97-D-0064	Lighting, Controls, Motor,VFD Install	Honeywell	1.38	0.7	7	1.86	107.62	2.57	174.73
Ft Bragg, Knox Street Warehouse	Lighting	Honeywell	1.35	0.3	11	0.91	108.53	1.23	175.96

Figure 11. Contingent Liability for ESPC Buyouts

Figure 11 displays the results of the AESOP model run which depicts the contingent liability for ESPC buyouts prioritized by savings to investment ratio. Note that the Army would need $2.6M for contingent liability to buy out the top 4 economically attractive ESPCs and $109M to buy out the top 19 ESPCs. The payback period (the number of years required for the cumulative savings

to equal the cumulative investment costs) for the top 19 ESPCs (by SIR) is in the range of 1-11 years, whereas the payback period for the top 4 ESPCs is 1-5 years.

3.6 New ECO Investment

New ECO Investment

Prioritized by SIR (Top 30)

New ECO Description / ECO Type	New ECO	SIR	NPV (PV-FY00$M)	Payback Period (Yrs)	ESPC Buyout & New ECO Invest Cost (PV-FY00$M)	Cum. New ECO Invest. Cost (PV-FY00$M)	Net Cost Sav./Avoid. (PV-FY00$M)	Cum Net Cost Sav./Avoid. (PV-FY00$M)
FH	FH Ground Source HP	3.83	13.4	3	4.73	4.73	18.08	18.08
UHC Plants	High Eff. Gas Boiler < 100hp	3.71	7.4	4	2.75	7.47	10.19	28.27
Building HVAC	Ventilation Heat Recovery	3.56	51.1	4	19.91	27.38	70.98	99.24
Electrical	High Eff Motors (Small)	3.53	34.3	4	13.53	40.92	47.79	147.04
Envelope	6.5 Inch Addtnl Clg Insul	3.43	10.8	4	4.43	45.35	15.19	162.23
Lighting	4' Fluorescent Lighting	3.35	281.92	3	120.08	165.43	402.00	564.23
UHC Plants	Gas Engine Water Pump	3.24	20.7	4	9.25	174.68	29.98	594.20
Building HVAC	SLDC Panels	3.06	23.8	4	11.54	186.22	35.36	629.57
FH	Progrmmbl Thermostats	3.01	10.0	3	4.94	191.16	14.89	644.46
Renewables	SolarWall for Maint Bldgs	2.76	20.8	5	11.79	202.95	32.55	677.01
UHC Plants	HiEff Chllrs >100 Tons	2.75	93.1	5	53.21	256.17	146.31	823.32
FH	Heat Pumps	2.74	97.5	5	55.91	312.08	153.37	976.69
FH	HiEff Oil Furn	2.44	20.0	5	13.89	325.97	33.86	1,010.55
UHC Plants	DF Gas Chillers >100Tons	2.40	1.7	6	1.24	327.21	2.96	1,013.52
FH	Hot Water Heat Pump	2.30	22.4	6	17.24	344.45	39.63	1,053.14
FH	High SEER AC	2.29	1.8	6	1.37	345.82	3.14	1,056.29
Lighting	High wattage incand replcmnt	2.28	28.4	5	22.26	368.08	50.69	1,106.97
FH	Rockwool Wall Insulation	2.27	15.2	6	11.98	380.06	27.22	1,134.19
Lighting	Occupancy Sensor	2.23	10.5	5	8.52	388.58	19.02	1,153.21
Electrical	Ventln Motor ASD (Medium)	2.20	0.6	3	0.49	389.07	1.09	1,154.30
UHC Plants	Storage Cooling Systems	2.15	22.1	5	19.13	408.21	41.23	1,195.53
Renewables	Wind Energy	2.14	30.0	6	26.27	434.47	56.23	1,251.76
Envelope	Radiant Barriers	2.12	7.0	6	6.19	440.66	13.14	1,264.90
UHC Plants	DF Gas Chillers 5-25Tons	2.11	5.3	6	4.77	445.43	10.06	1,274.96
Envelope	Window Film	2.09	2.8	3	2.62	448.05	5.47	1,280.43
FH	Insulate Ducts	2.08	8.4	6	7.74	455.80	16.11	1,296.54
Building HVAC	Desicnt Clg -LatSens 5-25ton	2.06	0.9	5	0.85	456.65	1.75	1,298.28
Lighting	High Pressure Sodium Lights	2.03	2.4	5	2.32	458.96	4.71	1,302.99
UHC Plants	HiEff Chllrs 50-100 Tons	2.00	0.4	7	0.40	459.36	0.79	1,303.79
FH	High Eff Refrig Replcmnt	1.99	5.7	7	5.70	465.06	11.36	1,315.14

Figure 12. New ECO Investment

Figure 12 shows the result of the AESOP model run that indicates the top 30 most economically attractive new energy conservation opportunity initiatives for the Army to invest in, in terms of savings to investment ratio. Note that the payback period of the top 30 new ECOs is from 3-7 years with investment costs in the range of \$4.7M - \$465M. The far right column indicates the cumulative cost savings/avoidance range of investing in new ECOs--in the range of \$18M to \$1.3B.

3.7 Investing in ESPC Buyouts and New ECOs, Prioritized by SIR

Portfolio	Description/ECO Type	ECO	SIR	NPV (PV-FY00$M)	Payback Period (Yrs)	ESPC Buyout & New ECO Invest Cost (PV-FY00$M)	Cum. ESPC Buyout & New ECO Invest Cost (PV-FY00$M)	Cum. ESPC Buyout Cost (PV-FY00$M)	Cum.New ECO Invest. Cost (PV-FY00$M)	Net Cost Sav./ Avoid. (PV-FY00$M)	Cum Net Cost Sav./ Avoid. (PV-FY00$M)
Investing in ESPC Buyouts and New ECOs Prioritized by SIR (Top 35)											
ESPC	Chiller Replacement	Corpus Christi Army Depot	7.12	3.4	1	0.56	0.56	0.56	-	4.00	4.00
New ECO	FH	FH Ground Source HP	3.83	13.4	3	4.73	5.29	0.56	4.73	18.08	22.08
New ECO	UHC Plants	High Eff. Gas Boiler < 100hp	3.71	7.4	4	2.75	8.03	0.56	7.47	10.19	32.27
New ECO	Building HVAC	Ventilation Heat Recovery	3.56	51.1	4	19.91	27.94	0.56	27.38	70.98	103.24
New ECO	Electrical	High Eff Motors (Small)	3.53	34.3	4	13.53	41.48	0.56	40.92	47.79	151.03
New ECO	Envelope	6.5 Inch Addtnl Clg Insul	3.43	10.75	4	4.43	45.91	0.56	45.35	15.19	166.22
New ECO	Lighting	4' Fluorescent Lighting	3.35	281.9	3	120.08	165.99	0.56	165.43	402.00	568.22
New ECO	UHC Plants	Gas Engine Water Pump	3.24	20.7	4	9.25	175.24	0.56	174.68	29.98	598.20
New ECO	Building HVAC	SLDC Panels	3.06	23.8	4	11.54	186.78	0.56	186.22	35.36	633.57
New ECO	FH	Progrmmbl Thermostats	3.01	10.0	3	4.94	191.73	0.56	191.16	14.89	648.46
ESPC	Air Propane Tank	Ft. Stewart Air Propane Plant	2.97	1.4	2	0.70	192.42	1.26	191.16	2.07	650.53
ESPC	Lighting, Motors, Insulation	Walter Reed AMC, DC/MD	2.86	0.2	5	0.09	192.51	1.35	191.16	0.25	650.78
ESPC	Boiler replacement, Lighting, EMS, VSD, NG Water Heaters, High-efficiency A/C Units, Deaerator tank	Walter Reed AMC, DC/MD	2.81	2.3	5	1.25	193.76	2.59	191.16	3.50	654.28
New ECO	Renewables	SolarWall for Maint Bldgs	2.76	20.8	5	11.79	205.55	2.59	202.95	32.55	686.83
New ECO	UHC Plants	HiEff Chllrs >100 Tons	2.75	93.1	5	53.21	258.76	2.59	256.17	146.31	833.14
New ECO	FH	Heat Pumps	2.74	97.5	5	55.91	314.67	2.59	312.08	153.37	986.51
New ECO	FH	HiEff Oil Furn	2.44	20.0	5	13.89	328.56	2.59	325.97	33.86	1,020.37
New ECO	UHC Plants	DF Gas Chillers >100Tons	2.40	1.7	6	1.24	329.80	2.59	327.21	2.96	1,023.34
New ECO	FH	Hot Water Heat Pump	2.30	22.4	6	17.24	347.04	2.59	344.45	39.63	1,062.96
New ECO	FH	High SEER AC	2.29	1.8	6	1.37	348.42	2.59	345.82	3.14	1,066.10
New ECO	Lighting	High wattage incand replcmnt	2.28	28.4	5	22.26	370.67	2.59	368.08	50.69	1,116.79
New ECO	FH	Rockwool Wall Insulation	2.27	15.2	6	11.98	382.65	2.59	380.06	27.22	1,144.01
New ECO	Lighting	Occupancy Sensor	2.23	10.5	5	8.52	391.17	2.59	388.58	19.02	1,163.03
New ECO	Electrical	Ventln Motor ASD (Medium)	2.20	0.6	3	0.49	391.67	2.59	389.07	1.09	1,164.12
New ECO	UHC Plants	Storage Cooling Systems	2.15	22.1	5	19.13	410.80	2.59	408.21	41.23	1,205.35
New ECO	Renewables	Wind Energy	2.14	30.0	6	26.27	437.07	2.59	434.47	56.23	1,261.58
New ECO	Envelope	Radiant Barriers	2.12	7.0	6	6.19	443.25	2.59	440.66	13.14	1,274.71
New ECO	UHC Plants	DF Gas Chillers 5-25Tons	2.11	5.3	6	4.77	448.03	2.59	445.43	10.06	1,284.78
New ECO	Envelope	Window Film	2.09	2.8	3	2.62	450.65	2.59	448.05	5.47	1,290.25
New ECO	FH	Insulate Ducts	2.08	8.4	6	7.74	458.39	2.59	455.80	16.11	1,306.36
New ECO	Building HVAC	Desicnt Clg -LatSens 5-25ton	2.06	0.9	5	0.85	459.24	2.59	456.65	1.75	1,308.10
New ECO	Lighting	High Pressure Sodium Lights	2.03	2.4	5	2.32	461.56	2.59	458.96	4.71	1,312.81
New ECO	UHC Plants	HiEff Chllrs 50-100 Tons	2.00	0.4	7	0.40	461.95	2.59	459.36	0.79	1,313.60
New ECO	FH	High Eff Refrig Replcmnt	1.99	5.7	7	5.70	467.65	2.59	465.06	11.36	1,324.96
New ECO	FH	Whole House Fans w/AC	1.99	2.3	7	2.28	469.93	2.59	467.33	4.54	1,329.50

Figure 13. Investing in ESPC Buyouts and New ECOs (prioritized by SIR)

Figure 13 displays the results of the AESOP model run that prioritized the top 35 savings combinations achievable through the apportionment of a fixed budget between ESPC buyouts and ECOs using the savings to investment ratio metric. Four ESPCs are included as economically attractive initiatives when the SIR metric is used. The funding wedge needed to buyout these 4 ESPCs and also invest in 31 new ECOs would be $470M. Note that this $470M would be invested in initiatives that have a payback period of 1-7 years in duration.

3.8 Investing in ESPC Buyouts and New ECOs, Prioritized by Simple Payback

An alternative algorithm to SIR is prioritizing by simple payback (PB) period.

The reasons to consider applying simple payback period are twofold:

1. It is Army policy, and,

2. It maximizes LIQUIDITY rather than RETURN; the greater flexibility that results allows you to avoid technological obsolescence risk.

However, it is of interest to note that, when using PB, one may miss big investment winners whose largest positive cash flows are outside the payback period. The PB criterion may also lead one to choose a project that from a discounted cash flow standpoint never pays back the investment in it (NPV<0, SIR<1). With PB, one takes a bird in the hand and minimizes risk; with SIR, one takes more risk in order to maximize returns.

Advantages of the simple payback metric:

a. Easy to calculate and understand.

b. Roughly accounts for riskiness since a shorter payback indicates a more liquid, less risky project.

c. Mitigates usage and technological obsolescence risk.

Disadvantages of the simple payback metric:

a. The timing of cash flows is ignored.

b. Cash flows beyond the payback period are ignored but may be significant.

Investing in ESPC Buyouts and New ECOs Prioritized by Payback (Top 30)											
Portfolio	Description/ECO Type	ESPC or New ECO	SIR	NPV (PV-FY00$M)	Payback Period (Yrs)	ESPC Buyout & New ECO Invest Cost (PV-FY00$M)	Cum. ESPC Buyout & New ECO Invest Cost (PV-FY00$M)	Cum. ESPC Buyout Cost (PV-FY00$M)	Cum. New ECO Invest. Cost (PV-FY00$M)	Net Cost Sav./ Avoid. (PV-FY00$M)	Cum Net Cost Sav./ Avoid. (PV-FY00$M)
ESPC	Chiller Replacement	Corpus Christi Army Depot	7.12	3.4	1	0.56	0.56	0.56	-	4.00	4.00
ESPC	Air Propane Tank	Ft. Stewart Air Propane Plant	2.97	1.4	2	0.70	1.26	1.26	-	2.07	6.07
New ECO	FH	FH Ground Source HP	3.83	13.4	3	4.73	5.99	1.26	4.73	18.08	24.15
New ECO	Lighting	4' Fluorescent Lighting	3.35	281.9	3	120.08	126.07	1.26	124.81	402.00	426.15
New ECO	FH	Progrmmbl Thermostats	3.01	10.0	3	4.94	131.01	1.26	129.75	14.89	441.04
New ECO	Electrical	Ventln Motor ASD (Medium)	2.20	0.59	3	0.49	131.50	1.26	130.24	1.09	442.13
New ECO	Envelope	Window Film	2.09	2.8	3	2.62	134.12	1.26	132.86	5.47	447.60
New ECO	UHC Plants	High Eff. Gas Boiler < 100hp	3.71	7.4	4	2.75	136.87	1.26	135.61	10.19	457.79
New ECO	Building HVAC	Ventilation Heat Recovery	3.56	51.1	4	19.91	156.78	1.26	155.52	70.98	528.76
New ECO	Electrical	High Eff Motors (Small)	3.53	34.3	4	13.53	170.31	1.26	169.05	47.79	576.56
New ECO	Envelope	6.5 Inch Addtnl Clg Insul	3.43	10.8	4	4.43	174.74	1.26	173.48	15.19	591.74
New ECO	UHC Plants	Gas Engine Water Pump	3.24	20.7	4	9.25	184.00	1.26	182.74	29.98	621.72
New ECO	Building HVAC	SLDC Panels	3.06	23.8	4	11.54	195.54	1.26	194.28	35.36	657.09
New ECO	Electrical	Ventln Motor ASD (Large)	1.83	0.2	4	0.21	195.74	1.26	194.48	0.38	657.46
ESPC	Air Propane Tank	Ft. McPherson/Gillem Air Propane Plant	1.68	1.8	4	2.56	198.30	3.82	194.48	4.31	661.77
New ECO	Building HVAC	EMCS/DDC	1.68	83.0	4	122.42	320.73	3.82	316.91	205.45	867.22
ESPC		Aliamanu Housing Area	1.27	1.9	4	7.16	327.88	10.98	316.91	9.08	876.30
ESPC	Lighting, Motors, Insulation	Walter Reed AMC, DC/MD	2.86	0.2	5	0.09	327.97	11.06	316.91	0.25	876.55
ESPC	Boiler replacement, Lighting, EMS, VSD, NG Water Heaters, High-efficiency A/C Units, Deaerator tank	Walter Reed AMC, DC/MD	2.81	2.3	5	1.25	329.22	12.31	316.91	3.50	880.05
New ECO	Renewables	SolarWall for Maint Bldgs	2.76	20.8	5	11.79	341.01	12.31	328.69	32.55	912.60
New ECO	UHC Plants	HiEff Chllrs >100 Tons	2.75	93.1	5	53.21	394.22	12.31	381.91	146.31	1,058.91
New ECO	FH	Heat Pumps	2.74	97.5	5	55.91	450.13	12.31	437.82	153.37	1,212.28
New ECO	FH	HiEff Oil Furn	2.44	20.0	5	13.89	464.02	12.31	451.71	33.86	1,246.14
New ECO	Lighting	High wattage incand replcmnt	2.28	28.4	5	22.26	486.28	12.31	473.97	50.69	1,296.83
New ECO	Lighting	Occupancy Sensor	2.23	10.5	5	8.52	494.80	12.31	482.49	19.02	1,315.85
New ECO	UHC Plants	Storage Cooling Systems	2.15	22.1	5	19.13	513.94	12.31	501.63	41.23	1,357.08
New ECO	Building HVAC	Desicnt Clg -LatSens 5-25ton	2.06	0.9	5	0.85	514.79	12.31	502.47	1.75	1,358.82
New ECO	Lighting	High Pressure Sodium Lights	2.03	2.4	5	2.32	517.10	12.31	504.79	4.71	1,363.53
ESPC	Lighting, Cooling Tower	West Point, Contract DACA87-96-D-0005	1.58	1.7	5	2.96	520.06	15.27	504.79	4.68	1,368.21
New ECO	Electrical	Ventln Motor ASD (Small)	1.53	0.9	5	1.69	521.75	15.27	506.48	2.57	1,370.78

Figure 14. Investing in ESPC Buyouts and New ECOs (prioritized by payback)

Figure 14 displays the results of the AESOP model run that prioritized the top 30 savings combinations achievable through the apportionment of a fixed budget between ESPC buyouts and ECOs using the Simple payback metric. Seven ESPCs are included as economically attractive initiatives when the simple payback metric is used. The funding wedge needed to buy out these 7 ESPCs and also invest in 23 new ECOs would be $522M. Note that this $522M would be invested in initiatives that have a payback period of 1-5 years in duration.

CHAPTER 4 FINDINGS

4.1 Economic Viewpoint

The AESOP Model provides the capability to evaluate the economic attractiveness of ESPC buyouts from both a pure investment strategy and a mixed investment strategy perspective. It also allows use of either SIR or PB to measure economic attractiveness (Figure 15). Recall that prioritizing by SIR maximizes profitability while prioritizing by payback maximizes liquidity. In general, those ESPCs that are economically unattractive for contractors also appear to be poor buyout prospects.

4.1.1 Pure Investment Strategy

From a pure investment strategy perspective, roughly two-thirds of ESPCs are attractive buyout targets.

Using SIR to evaluate ESPC Buyout Portfolio

SIR Rating	Count	Total Investment (PV-FY00$M)	Total Savings (PV-FY00$M)
Attractive (SIR>1)	33	202	283
Unattractive (SIR<=1)	19	87	61
Total	52	289	344

SIR Rating	Count	Total Investment (PV-FY00$M)	Total Savings (PV-FY00$M)
Attractive (SIR>1)	63%	70%	82%
Unattractive (SIR<=1)	37%	30%	18%
Total	100%	100%	100%

Using PB to evaluate ESPC Buyout Portfolio

PB Rating	Count	Total Investment (PV-FY00$M)	Total Savings (PV-FY00$M)
Attractive (PB<=10)	34	131	202
Unattractive (PB>10)	18	158	142
Total	52	289	344

PB Rating	Count	Total Investment (PV-FY00$M)	Total Savings (PV-FY00$M)
Attractive (PB<=10)	65%	45%	59%
Unattractive (PB>10)	35%	55%	41%
Total	100%	100%	100%

Figure 15. Measuring Economic Attractiveness, Savings to Investment Ratio and Payback

4.1.2 Mixed Investment Strategy

From a mixed investment strategy viewpoint, given some plausible investment level, a small portion of ESPC buyouts is attractive.

Our results when using the savings to investment ratio metric show:

- Four ESPCs are included as economically attractive initiatives.
- Funding wedge needed to buy out these 4 ESPCs and invest in 9 new ECOs would be $194M.
- Investment of this $194M in initiatives has a payback period of 1-5 years.

Our results when using the simple payback metric show:

- Seven ESPCs are included as economically attractive initiatives.
- Funding wedge needed to buy out these 7 ESPCs and also invest in 23 new ECOs would be $522M.
- Investment of this $522M in initiatives has a payback period of 1-5 years.

4.1.3 Summary of Economic Findings

Because ESPCs are a form of passthrough financing in which the Government is essentially funding capital investment via third party commercial sources, and because this passthrough rate is always higher than the Government's treasury borrowing rate, it usually makes economic sense to buy out these ESPCs if no better investment opportunities exist. However, many new investment ECOs promise a high enough return for the Government to invest in them instead. Nevertheless, issues outside the scope of this analysis (e.g., color of money, operational, or political issues) may influence whether ESPC buyouts should be undertaken.

4.2 Risk Viewpoint

Because energy *usage* rate risk is not borne by ESPC contractors but by the Government, and because the Government's exposure to it is unchanged by an ESPC buyout, it is neither an incentive nor a disincentive to the Army's buying out ESPCs.

Because energy *inflation* rate risk is not borne by ESPC contractors but by the Government, and because the Government's exposure to it is unchanged by an ESPC buyout, it is neither an incentive nor a disincentive to the Army's buying out ESPCs.

By retaining energy price and facility usage rate risk, the Government avoids paying the contractor a premium for doing the same. Therefore, ESPCs are more affordable.

The contractor's assumption of performance risk provides an incentive for him to save the Government money.

Synopsis of risk in ESPC buyouts:

- Because windfalls from energy price increases already belong to the Army, higher energy prices should not be an impetus for buyouts.

- Conversely, because the risk of unrealized savings due to low usage rates is not borne by ESPC contractors, lower usage rates are not an impediment to buyouts.

4.3 Concluding Remarks

1. Consider the opportunity costs (economic, political, environmental, etc.) associated with ESPC buyouts before investing in them.

2. Buy out only those ESPCs which provide a positive return on investment from a net present value perspective. Approximately two-thirds of the ESPCs examined in our study meet this criterion.

3. If buying out less than that two-thirds of the ESPC portfolio that is economically attractive, then prioritize buyouts according to their (1) SIR if the objective is to maximize return on investment, (2) payback period if the objective is to maximize liquidity.

APPENDIX A. PROJECT CONTRIBUTORS

1. PROJECT TEAM

a. Project Director

Mr. James Keller, Jr., Resource Analysis Division

b. Team Member

Ms. Doris Futrell

2. PRODUCT REVIEW

Dr. Ralph E. Johnson, Quality Assurance
Ms. Nancy M. Lawrence, Publications Center, Mission Support

3. EXTERNAL CONTRIBUTORS

Mr. Satish Sharma, Office, Assistant Chief of Staff for Installation Management
Ms. Regina Larabee, Office, Assistant Chief of Staff for Installation Management
Ms. Carrie Klug, Office, Assistant Chief of Staff for Installation Management

Ms. Carol Sargent, Huntsville Engineering Support Center
Ms. Sallie Parsons, Huntsville Engineering Support Center
Mr. Bob Starling, Huntsville Engineering Support Center

Mr. Richard Mann, Defense Energy Support Center

Mr. Buddy Scott, Walter Reed Army Medical Center

APPENDIX B. REQUEST FOR ANALYTICAL SUPPORT

P *Performing Division:* RA *Account Number:* **2000041**

A *Tasking:* Verbal *Mode (Contract-Yes/No):* No

R *Acronym:* **AESOP**

T

Title: Analysis of Energy Saving Outsourcing Portfolios

1 *Start Date:* 01-Aug-99 *Estimated Completion Date:* 31-Dec-99

Requestor/Sponsor (i.e., DCSOPS): ACSIM *Sponsor Division:* FD

Resource Estimates: *a. Estimated PSM:* 6 *b. Estimated Funds:* $0.00

c. Models to be **REEP, EXCEL**

Description/Abstract:

The objective of AESOP is to assess the costs and benefits of buying out a portion of the Army's Energy Savings Performance Contract (ESPC) portfolio.

Study Director/POC Signature: **Original Signed** *Phone#:* 703-806-5388

Study Director/POC: **Mr. James Keller Jr.**

If this Request is for an External Project expected to consume 6 PSM or more, Part 2 Information is Not Required. See Chap 3 of the Project Directors' Guide for preparation of a Formal Project Directive.

Background:

P The Army is currently a party to scores of ESPCs. Under these ESPCs, contractors implement energy saving technology at Army facilities in return for a share of the annual dollar savings stream that the technology creates. The relative utility of these

A performance contract vehicles vis-a-vis simple up-front investment in the same technologies is called into question, as well as the efficacy of buyouts to convert the former into the latter.

R *Scope:*

T Consider the Army's entire ESPC portfolio.

2

Issues:

Questions:

1. How much funding should be programmed for ESPC buyouts?
2. What are the pros and cons of ESPC buyouts?

Milestones:

Brief Results - 13 Dec

Publish - February

Signatures *Division Chief Signature:* **Original Signed and Dated** *Date:*

Division Chief Concurrence: Mr. Steven Siegel

Sponsor Signature: **Original Signed and Dated** *Date:*

Sponsor Concurrence (COL/DA Div Chief/GO/SES)

APPENDIX C. ARMY ESPC PORTFOLIO

Army ESPC Portfolio					
Prioritized by SIR (Top 19)					
Installation	**ESPC Description/ECO Type**	**Contractor**	**SIR**	**NPV (PV-FY00$M)**	**Payback Period (Yrs)**
Corpus Christi Army Depot	Chiller Replacement	Sempra Energy Serv. (CES/Way)	7.12	3.4	1
Ft. Stewart Air Propane Plant	Air Propane Tank	Sempra Energy Serv. (CES/Way)	2.97	1.4	2
Walter Reed AMC, DC/MD	Lighting, Motors, Insulation		2.86	0.2	5
Walter Reed AMC, DC/MD	Boiler replacement, Lighting, EMS, VSD, NG Water Heaters, High-efficiency A/C Units, Deaerator tank		2.81	2.3	5
Ft Carson, CO	Chiller Replacement	CES Way Int'l	1.83	0.6	6
Ft. McPherson/Gillem Air Propane Plant	Air Propane Tank	Systems Corp	1.68	1.75	4
Ft Dix, Barnes Fed Bdg, DACA87-96-F-0004	Lighting, Chiller Pumps, Damper Replacement,Toilets	Noresco	1.62	1.1	8
Fts Belvoir/McNair/Meade/ Myer/A.P. Hill	Lighting, EMCS, VFDs, Centralized Cooling, Geothermal Heat Pumps, VAV conversions, Boiler replacements, absorption chiller		1.59	45.0	8
West Point, Contract DACA87-96-D-0005	Lighting, Cooling Tower	Noresco	1.58	1.7	5
Ft Bragg, Simmons AF Hangar	Lighting, Boilers, Natural Gas	Honeywell	1.55	3.4	9
Ft Stewart, DACA87-97-D-0015	Lighting	ERI Services Inc	1.51	0.9	6
Walter Reed AMC, DC/MD	Lighting, Motors, Steam traps, Water valves/meters		1.48	0.9	7
Ft Bragg, Simmons AF Bdg	Lighting	Honeywell	1.47	0.1	9
Ft Leonard Wood, MO	Air Cooled Condensing Units & Evaporators	Sempra Energy Serv.	1.45	1.6	8
Walter Reed AMC, DC/MD	Chiller Replacement, controls & plant upgrade		1.43	1.5	9
Ft Stewart, DACA87-97-D-0015	Lighting II	ERI Services Inc	1.40	0.4	7
Blanchfield Army Community Hospital			1.39	0.3	7
Ft Dix, Barnes Fed Bdg, DACA87-97-D-0064	Lighting, Controls, Motor,VFD Install	Honeywell	1.38	0.7	7
Ft Bragg, Knox Street Warehouse	Lighting	Honeywell	1.35	0.3	11
Ft Bragg, A-Area Veh Maint Fac	Lighting, HVAC, Controls	Honeywell	1.34	0.3	11
Ft Bragg, O-Club, DACA87-97-D-0013	Lighting, HVAC, Controls	Honeywell	1.30	0.1	11
Aliamanu Housing Area			1.27	1.9	4
Ft Bragg, Area Barracks	Lighting	Honeywell	1.21	0.1	5
Fox Army Health Center, Huntsville, AL			1.19	0.4	12
Def Sup Ctr, Richmond	Lighting, Nat Gas Sys Conv, Peak Shaving	Duke Solutions	1.19	1.5	9
Ft Benning, GA,	Lighting	Duke Engineering	1.19	0.1	7
Ft Bragg, JSOC Facilities	DiesGen Pk Shaving, Lighting, HVAC, Controls	Honeywell	1.19	0.6	10
VA Hospital, Omaha, Nebraska	Absorber Chiller, Controls	Abacus	1.16	0.3	9
USAG - Hawaii	Daylighting		1.16	0.1	7
Walter Reed Army Medical Center - Bdg 2			1.13	8.2	13
Ft. Huachuca, AZ	Photovoltaic, Lighting, Daylighting		1.10	0.0	6
Ft. Huachuca, AZ	Lighting, LED Traffic Lights, Chiller		1.04	0.0	10
Ft Bragg, 82nd AB Div Facilities	Lighting	Honeywell	1.04	0.1	12
Ft. Polk Ground Source Heat Pumps	Groung Source Heat Pumps		0.90	(1.3)	12
Veterans Integ Serv Network -6	Lighting, HVAC, Chiller, Control, Water Serv, Boiler Motor, Laundry/Steam Trap Improv (eight hospitals)	Duke Solutions	0.81	(5.3)	15
West Point, NY	Lighting		0.68	(0.1)	7
West Point, NY	Lighting		0.67	(0.0)	8
West Point, NY	Lighting		0.66	(0.1)	9
West Point, NY	Lighting		0.66	(0.0)	9
Ft Bragg	Knox Street Warehouse		0.65	(0.3)	21
Ft. Campbell, KY	Lighting		0.65	(0.3)	10
Tobyhanna AD, PA	Decentralization of Heating Plant		0.64	(10.7)	21
Fort McCoy, WI	Lighting and Controls		0.64	(0.2)	14
Marine Corps Base Hawaii - Lighting TO 1			0.63	(0.0)	10
West Point, NY	Lighting		0.62	(0.0)	8
Ft. Knox, KY	Lighting		0.60	(0.2)	11
Ft. Devens, MA	Lighting			(0.4)	11
West Point, NY	HVAC (Keller Hospital)		0.53	(0.5)	12
Redstone Arsenal	Lighting		0.47	(0.5)	15
Barnes/Sage Bldg.	Lighting, Motors, Controls		0.40	(1.0)	16
Ft. Benning, GA	Lighting		0.38		13
Ft. Polk, LA	Boiler replacements, Variable volume pumping, lighting, HVAC Controls, Water conservation		0.06	(0.5)	22

GLOSSARY

ACSIM	Assistant Chief of Staff for Installation Management
AESOP	Analysis of Energy Saving Outsourcing Portfolio
CAA	Center for Army Analysis
DESC	Defense Energy Support Center
ECO	energy conservation opportunities
ESPC	Energy Saving Performance Contract
FY	fiscal year
HESC	Huntsville Engineering Support Center
NPV	net present value
O&M	operation and maintenance
PB	simple payback
PV	present value
REEP	Renewables and Energy Efficiency Planning (REEP) Study
SIR	savings to investment ratio